Decision Rationale

Total Maximum Daily Load of
Fecal Coliform for Mountain Run

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) of Fecal Coliform for Mountain Run submitted for final Agency review on March 30, 2001. Our rationale is based on the TMDL submittal document to determine if the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDLs can be met.

II. Background

Located in Culpeper County, Virginia, the overall Mountain Run watershed is approximately 58,000 acres. The TMDL addresses 7.58 miles of Mountain Run from its confluence with Flat Run extending downstream to its confluence with the Rappahannock River. Agriculture is the predominant land use in the watershed. Mountain Run is a tributary to the Rappahannock River, which discharges to the Chesapeake Bay.

In response to Section 303 (d) of the Clean Water Act (CWA), the Virginia Department of Environmental Quality (VADEQ) listed 7.58 miles of Mountain Run as being impaired by elevated levels of fecal coliform on Virginia's 1998 Section 303 (d) list. Mountain Run was listed for violations of Virginia's fecal coliform bacteria standard for primary contact. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore it can be found in the fecal wastes of warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, it indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms. Mountain Run, identified as watershed VAN-E09R, was given a high priority for TMDL development. Section 303 (d) of the Clean Water Act and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and

other controls do not provide for the attainment of Water Quality Standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Mountain Run, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. These levels of fecal coliform will ensure that the Primary Contact usage is supported. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality for conventional pollutants and toxicants[2]. More specifically HSPF uses precipitation data for continuous and storm event simulations to determine total fecal loading to Mountain Run from built-up areas, cropland, forest, pasture, loafing lots, and rural residential. The total land loading of fecal coliform is the result of the application of manure (livestock wastes), direct deposition from livestock and wildlife (geese, duck, racoon, muskrat, and deer) to the land, fecal coliform production from pets, and septic system failure.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources the HSPF model accounts for the buildup and washoff of pollutants from these areas. Build up (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove pollutants between storms. Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform reaching the stream from land based sources. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes did not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by urban runoff, cattle in-stream, septic systems, and straight pipes.

Table #1 summarizes the specific elements of the TMDL.

Parameter	TMDL(cfu/yr)	WLA(cfu/yr)	LA(cfu/yr)	MOS[1] (cfu/yr)
Fecal Coliform	1.194×10^{15}	9.955×10^{12}	1.124×10^{15}	5.968×10^{13}

1 Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia.

EPA believes it is important to recognize the conceptual difference between directly deposited loads (loads deposited to the stream) and land applied loads. Directly deposited loads represent the actual amount of fecal coliform being deposited into the stream segments. While values for flux sources (land applied sources) represent the amount of fecal coliform deposited to land. The actual amount of fecal coliform which reaches the stream will be less than the amount of fecal coliform deposited to land due to die-off, geography (distance to the stream), soil, and application method. The HSPF model, which considers landscape processes which affect the total amount of fecal coliform runoff from land uses, determines the amount of fecal coliform which will reach the stream segment.

The United States Fish and Wildlife Service has been provided with a copy of this TMDL. A March 29, 2000 letter from the USFWS states "There are no known occurrences of federally listed species, nor is there designated critical habitat in the vicinity of the project."

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the 8 basic requirements for establishing a fecal coliform TMDL for Mountain Run. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (directly deposited into the River and urban runoff) have caused violations of the water quality standards and designated uses on Mountain Run. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous concentration of no more than 1,000 cfu/100ml. Two or more samples over a thirty-day period are required for the geometric mean standard. Therefore, most violations of the State's water quality standard are due to violations of the instantaneous standard.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and direct deposition sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Mountain Run will ensure that the criterion is attained.

Fecal coliform production rates within the watershed is attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed and their fecal production rates, land uses, urban runoff, weather, stream geometry, etc. This information is used in the development of the model.

The hydrology component of the model was developed using the flow data from USGS

gage 01665000, which is located within the Mountain Run watershed. Data from this gage was available from January 1979 through September 1997. The hydrologic calibration was performed using data from 1986 through 1989. The model was then transferred to the downstream portion of Mountain Run. The calibration was performed using the USGS's HSPEXP program for analyzing calibration parameters. Thirty-two storms were selected from the 1/1/1986 to 12/31/1989 calibration period[3]. The percent error between observed and simulated flows were within the desired criterion of 10%. The withdrawal of water from the Culpeper Water Filtration Plant (WFP) and the discharge from the Culpeper Waste Water Treatment Plant (WWTP) had to be accounted for in the model as well. The WFP withdrew 1.39 million gallons a day (mgd) from Lake Pelham while the WWTP discharged 2.17 mgd to Mountain Run downstream of Culpeper. The water quality calibration used data from 1995 through 1997.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for Mountain Run.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land base, precipitation driven nonpoint source areas (cropland, pasture, loafing lots, rural residential, built-up areas, and forest) from flux sources, directly deposited nonpoint sources of fecal coliform (livestock in-stream, straight pipes, and lateral flow from septic systems), and point sources (Culpeper Waste Water Treatment Plant, Mt. Dumplin Sewage Treatment Plant (STP), Ferguson STP, and Mountain Run STP). Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

EPA regulations require that an approvable TMDL include individual Waste Load Allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the

[3]Yagow, G., 2001. Fecal Coliform TMDL Mountain Run Watershed Culpeper County, Virginia.

WLAs established for that point source.

There are several point sources on Mountain Run itself. However, the only regulated point source currently discharging is the Culpeper WWTP. There are three other facilities which although permitted to discharge fecal coliform are not currently discharging to Mountain Run. Under the future and all TMDL reduction scenarios, all of the facilities were modeled as discharging to the stream. The Waste Load Allocation for each facility was determined by multiplying the permitted fecal coliform concentration by the maximum flow. All of these facilities are required to treat their effluent for fecal coliform and therefore have concentrations far lower than their permitted limit. Table #2 documents the WLA for all of the permitted facilities discharging fecal coliform to Mountain Run. It should be noted that the Town of Culpeper's storm sewer system was modeled as a nonpoint source and is not yet permitted. In order to insure compliance with 40 CFR 122.44 (d) (vii) (B), the TMDL will need to be modified prior to the issuance of the Town of Culpeper's MS-4 permit to provide a WLA for that permitted discharge.

Table 2 - Summarizes the WLAs for each point source

Facility	Permit Number	Waste Load Allocation
Mt. Dumplin STP	VA0087149	8.29E+11
Ferguson STP	VA0062529	6.90E+09
Mountain Run STP	VA0090212	8.29E+11
Culpeper WWTP	VA0061590	8.29E+12
Total WLA	N/A	9.95E+12

Load Allocations

According to federal regulations at 40 CFR 130.2 (g), load allocations are best estimates of the loading, which may range form reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible natural and nonpoint source loads should be distinguished.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, and lateral flow from septic tanks within 500 feet of the stream. These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore impact water quality during low and high flow events. These sources were modeled as though they were point sources.

Weather data is a critical component of the model. Wet weather events provide a transport mechanism (runoff) for land applied wastes to reach the stream. Therefore, it is vital that the weather data used accurately reflects the conditions in the watershed. A National

Climatic Data Center cooperative observer station in Culpeper was used as the primary weather data source. Data from the Remington, Elkwood, and Piedmont Research Station was used to fill data gaps.

Urban runoff was the loading associated with runoff from impervious areas in the Town of Culpeper which bypass the WWTP and discharge directly to the stream. The runoff is from parking lots and other impervious structures which contain the fecal material from birds, pets, and rodents. A wet weather event is needed to transport this load to the stream. Fecal coliform was more easily transported from these impervious areas than from agricultural lands due to differing coefficients of runoff for these surfaces. Lower intensity storms were therefore, capable of transporting fecal material from built-up areas into the stream.

Subwatershed #9 of the TMDL model contains the majority of the Town of Culpeper, with all in-stream inputs of fecal coliform blocked by Lake Pelham[4]. Therefore monitored fecal coliform in this segment were attributed to urban sources. Monitoring data from 2000 has documented fecal coliform concentrations at the analysis threshold 8,000 cfu/100ml within this reach.

Urban runoff was modeled as a nonpoint source in the model and its loading was incorporated into the LA. The Town of Culpeper will be receiving an MS-4 permit in the future, in order for this permit to be approvable, it must be consistent with the WLA. Therefore, the storm sewer loading must be moved from the LA to the WLA prior to the issuance of the permit. Table #3 documents the loading to Mountain Run from each land use. The TMDL called for reductions in nonpoint source loading from cattle in-stream, urban runoff, straight pipes, and septic systems. Table #3A documents the reductions needed in each watershed for straight pipes, cattle in-stream, septic systems, and urban runoff.

Table #3 - Documents the edge of stream loads under current conditions and TMDL allocation plan #4 (cfu/yr x 10,000,000,000).

Source	Current Load	Allocated Load
Urban	2,241	2,534
Rural Residential	114	34
Forest	880	833
Cropland	1,228	1,218
Pasture	70,162	69,374

[4]Yagow, G., 2001. Fecal Coliform TMDL for Mountain Run Watershed Culpeper County, Virginia.

Loafing Lot	8,421	8,419
Impervious Washoff	22,323	5,938
Cattle In-stream	6,663	342
Straight Pipes	2,009	0

Table #3A - Load reductions in each watershed.

Source	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Urban Washoff				95				95	96	95	95	95		95		
Cattle in-stream		95	90	90	95	95	95			95	100	95		90		
Septic systems	100	100	100	100	100	100	100			100	100	100		100		
Straight Pipes		100	100	100	100	100	100	100	100	100	100	100	100	100		

3) The TMDL considers the impacts of background pollution.

The Mountain Run TMDL considered background as being the load delivered by wildlife. In this TMDL, wildlife was not modeled as delivering a fecal coliform load directly to the stream. Wildlife habitats were documented within the watershed. The fecal coliform loading was determined by estimating the wildlife population in the habitat and multiplying the population by the fecal coliform produced per animal. Lake Pelham was treated as a sink which prevented the migration of the upstream fecal coliform load to the downstream portion of the watershed.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Mountain Run is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[5]. Critical conditions are a combination of

[5]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional

environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to, insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were mixtures of dry and wet weather driven sources. The reductions called for in this TMDL will reduce the fecal coliform loading to the stream in both wet and dry weather conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis will effectively consider seasonal environmental variations.

The model also accounted for seasonal variations in fecal coliform loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter. Therefore, the loading from cattle in-stream was greatest in the summer when there were more cattle in the stream for longer periods of time. This loading was further enhanced by the low flows encountered during the summer months.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the wasteload allocation, load allocation, or TMDL.

Virginia used an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL.

Management Division Directors, August 9, 1999.

7) The TMDLs have been subject to public participation.

This TMDL was subject to a number of public meetings. Three public meetings were held in Culpeper, VA. The meeting were held on June 2, 1999, September 27, 1999, and May 10, 2000 and were intended to address initial questions and concerns regarding outreach issues and the TMDL process.

The first public meeting was held on June 2, 1999 in Culpeper and was announced in the Virginia Register on May 24, 1999 initiating the public comment period. The public comment period ended on June 23, 1999. The second public meeting was announced in the Virginia Register on September 13, 1999. The second public comment period closed 30-days after the announcement in the Virginia Register (October 12, 1999). The May 10, 2000, public meeting was announced in the April 24, 2000 Virginia Register and the public comment period closed on September 30, 2000. Several written comments were sent to the Commonwealth on this TMDL. The Commonwealth responded to these comments and submitted these responses to EPA.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the Clean Water Act, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.